DEPARTMENT OF NATURAL RESOURCES

CONJOINED WHITE-TAILED DEER (*ODOCOILEUS VIRGINIANUS*) FAWNS[1]

Gino J. D'Angelo, Louis Cornicelli, Christina E. Clarkson, and Arno Wuenschmann

SUMMARY OF FINDINGS

In May 2016, conjoined white-tailed deer (*Odocoileus virginianus*) fawns were found deceased in southeastern Minnesota. The bodies of the fawns were joined ventrally and laterally with two separate necks and heads. This is the first case described of conjoined white-tailed deer brought to full-term gestation and delivered.

White-tailed deer are the most abundant and widely distributed species of the New World deer (Heffelfinger 2011). Most female white-tailed deer ≥2 yrs old carry twins (DeYoung 2011). Conjoined twins are rare in Cervidae, but more commonly reported in humans and domestic animals. Kompanje and Hermans (2008) found 19 cases of conjoined twins in non-domestic terrestrial mammals in the literature between 1671 and 2006. These reports included five occurrences in cervids: white-tailed deer, moose (*Alces alces*), and red deer (*Cervus elaphus*). Only 2 cases of conjoined twins were reported previously in white-tailed deer. According to criteria presented by Spencer (2003), both cases would be classified as Parapagus dicephalus- a body united ventrally with 2 separate heads. In Michigan, US, a mid-gestation, two-headed white-tailed deer fetus was found during necropsy of an adult doe (Fay 1960). A similar late-gestation fetus was reported in an adult doe in western South Dakota, US (Severson et al. 1972).

We present the first known case of conjoined white-tailed deer fawns, which were birthed. In late-May 2016, a mushroom gatherer found a 2-headed white-tailed deer fawn near Freeburg, Houston County, Minnesota, US. The specimen was found on the forest floor and was reported to be clean, dry, and freshly dead. No other deer or signs of parturition were noted in the area. The specimen was submitted to the Minnesota Department of Natural Resources (MNDNR) in excellent condition and was frozen until necropsy.

The specimen presented here demonstrated Parapagus dicephalus with ventral fusion along the length of the body (Figure 1). Whereas the previous cases reported in white-tailed deer had a shared neck and bifurcation in the proximal cervical vertebrae, these fawns had 2 separate necks and heads. External body parts appeared symmetrical and normal except for bifurcation of the neck. The fawns had a single umbilicus, which was raw and free of umbilical cord. There was one vagina and one anus with fecal pellets present. The pelage was typical of neonatal white-tailed deer with spot patterning that continued through both necks and heads. The fawns weighed 3.6 kg, which was slightly greater than neonatal birth-masses reported for fawns in northeastern Minnesota (Carstensen et al. 2009). Length from base of the tail to bifurcation of the neck was 32 cm and both neck and head lengths were 24 cm. Chest girth was 33 cm. We estimated the age of the fawns to be 0-4 days postpartum based on hoof growth (Sams et al. 1996). Given the timing, morphology, and evidence at the site of collection, we believe the fawns were carried full-term. The lungs sank when placed in water, indicating the fawns were delivered stillborn.

---

[1]Manuscript published in the American Midland Naturalist

Examination via 3D computed tomography and magnetic resonance imaging indicated duplication of skull, cervical vertebrae, several ribs, most thoracic vertebrae, and the first sternebrae. Caudal to the region of the 9th thoracic vertebra a single vertebral column was evident (Figure 2A). No other major skeletal anomalies were noted. The gastrointestinal tracts were separate, only the right tract was complete from esophagus to anus (Figure 2B). The left gastrointestinal tract consisted of 2 non-continuous segments, one comprised of a blind-ended esophagus and a second section of gut consisting of a dilated segment of forestomach with duodenum. This latter portion of gut also ended blindly. The liver was malformed and shared. Four segments of splenic tissue were present. Two separate hearts shared a pericardial sac (Figure 2C).

Spencer (2003) reviewed approximately 1,000 cases of conjoined human twins, including 305 parapagus, and postulated that all conjoined twins arise from 2 separate notochords (i.e., forerunner of vertebral column) on 2 originally separate embryonic discs. An alternative theory suggests that monozygotic conjoined twins occur when splitting of the embryo is incomplete at the primitive streak stage of development (Kaufman 2004). Although conjoined twins are thought to be most common and well-studied in humans, causes are speculative.

ACKNOWLEDGMENTS

We wish to acknowledge Kevin Serres for collecting and reporting the specimen, and Thomas Hemker and Donald Nelson of the MNDNR for aiding in reporting of the case. Robert Utne and Jessica Brooks of Wild Images In Motion Taxidermy mounted the specimen free of charge. The mount will be on display at the MNDNR headquarters in St. Paul, Minnesota, US. A skeletal preparation of the specimen will be housed at the University of Minnesota Veterinary Anatomy Museum in St. Paul, Minnesota, US. This study was funded by the Minnesota Department of Natural Resources.

LITERATURE CITED

Carstensen M.C, Delgiudice G.D, Sampson B.A, Kuehn D.W. 2009. Survival, birth characteristics, and cause-specific mortality of white-tailed deer neonates. *Journal of Wildlife Management* 73:175-183.

DeYoung C.A. 2011. Population dynamics. In: *Biology and management of white-tailed deer*, Hewitt DG, editor. CRC Press, Boca Raton, Florida, pp. 147-180.

Fay L.D. 1960. A two-headed white-tailed deer fetus. *Journal of Mammalogy* 41:411-412.

Heffelfinger J.R. 2011. Taxonomy, evolutionary history, and distribution. In: *Biology and management of white-tailed deer*, Hewitt DG, editor. CRC Press, Boca Raton, Florida, pp. 3-39.

Kaufman M.H. 2004. The embryology of conjoined twins. *Child's Nervous System* 20:508-525.

Kompanje E.J.O, Hermans J.J. 2008. Cephalopagus conjoined twins in a leopard cat (*Prionailurus bengalensis*). *Journal of Wildlife Diseases* 44:177-180.

Sams M.G, Lochmiller R.L, Hellgren E.C, Warde W.D, Varner L.W. 1996. Morphometric predictors of neonatal age for white-tailed deer. *Wildlife Society Bulletin* 24:53-57.

Severson K.E, Messner H.E, Dietz D.R. 1972. Two-headed white-tailed deer fetus. *American Midland Naturalist* 88:464-465.

Spencer R. 2003. Conjoined twins: developmental malformations and clinical implications. Johns Hopkins University Press, Baltimore, Maryland, 476 pp.

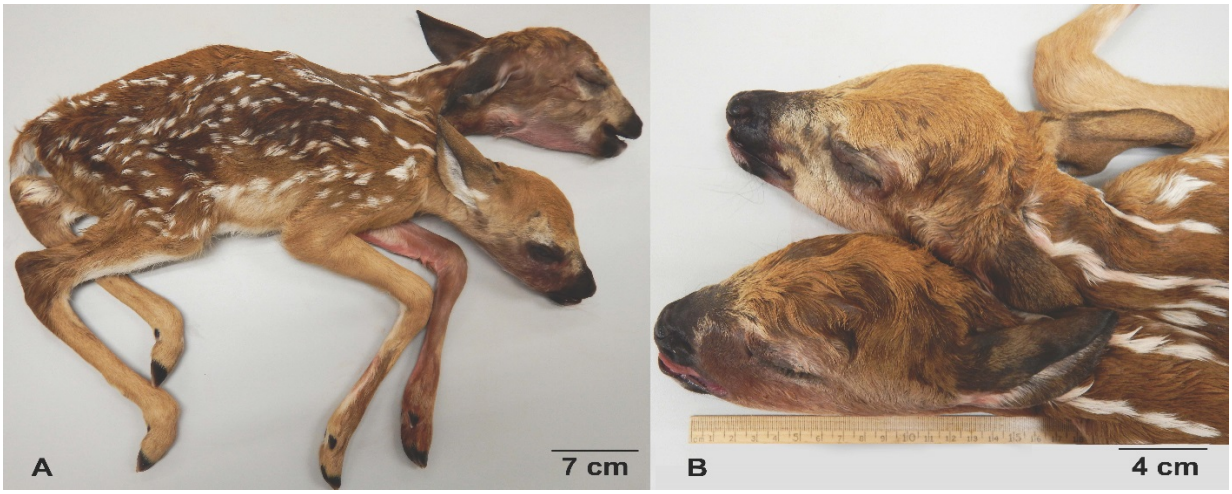

Figure 1. Stillborn, conjoined white-tailed deer fawns (*Odocoileus virginianus)* collected in Houston County, Minnesota, USA, during May 2016. A. Lateral view of entire specimen. B. Close-up of head region.

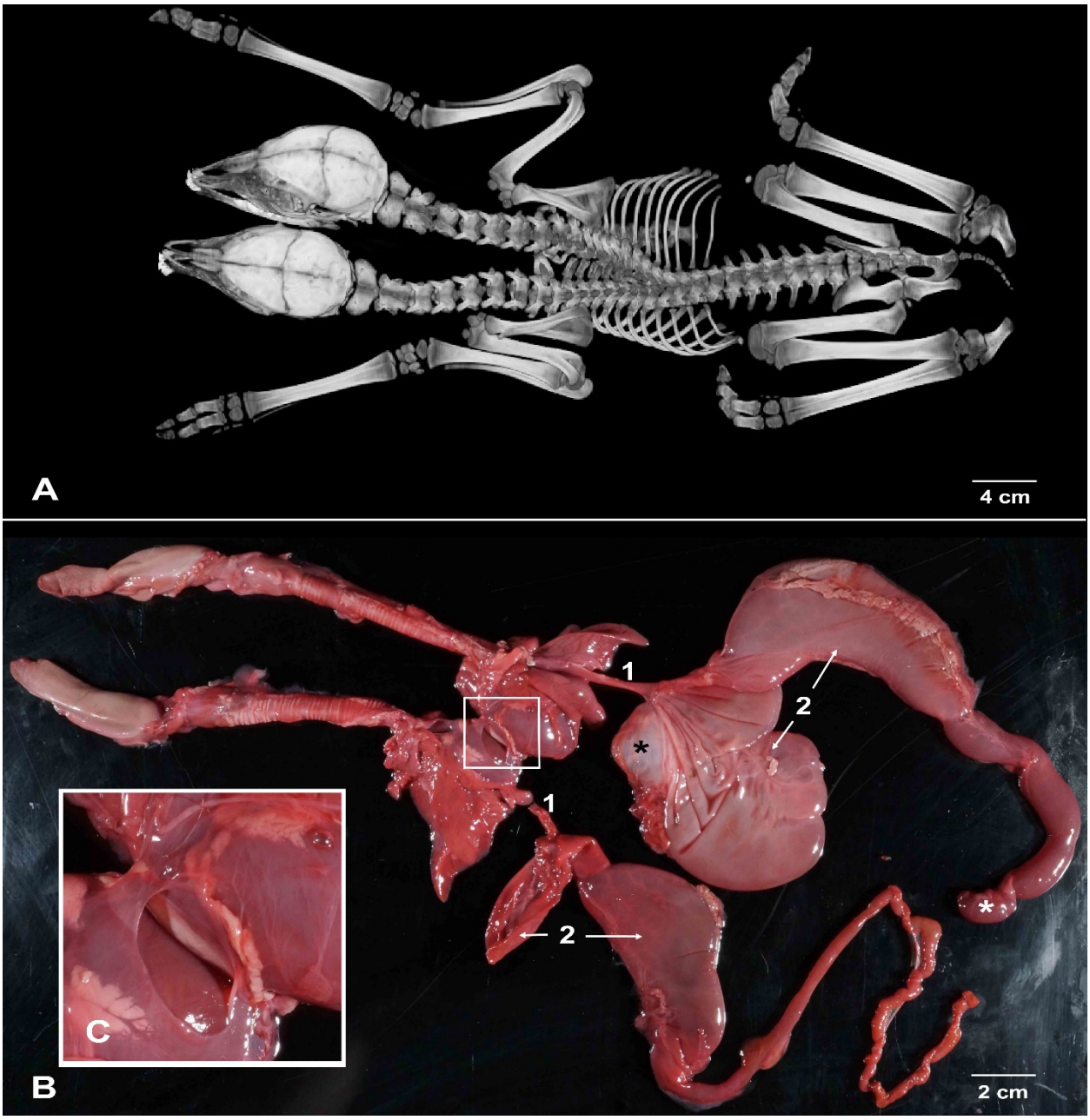

Figure 2. A. 3D computed tomography of stillborn, conjoined white-tailed deer fawns (*Odocoileus virginianus*) collected in Houston County, Minnesota, USA, during May 2016. This image documents the grossly visible separate head-neck regions and duplication of most thoracic vertebrae, which then become a single vertebral column. B. Viscera removed at necropsy from conjoined white-tailed deer fawns. Two esophagi (1) and two forestomachs (2) were present. The left head was connected with the abnormally developed upper visceral tracts-the esophagus ended in a blind sac (black asterisk) and the forestomach/upper duodenum was dilated and also ended blindly (white asterisk). The lower tract associated with the right head was complete. Note: the small separation seen in the esophagus of the lower tract and the removal of part of the lower gastrointestinal tract was done at necropsy. C. Enlarged view of boxed area showing separate hearts within a shared pericardial sac. Note: pericardial sac was incised at necropsy.